

## CLAIMS

What is claimed is:

1. A waveguide optical amplifier package comprising:

(a) a circulator having an input port adapted to receive an input beam and an output port and adapted to propagate an output beam having a power level greater than said input beam, said circulator being adapted to create a first beam and a second beam from said input beam; and

(b) a planar waveguide optically communicating with said circulator, said waveguide being adapted to receive said first beam and said second beam and reflect an amplified first beam and an amplified second beam that have greater power levels than said first beam and said second beam, wherein said circulator is adapted to combine said first amplified beam and said second amplified beam to form said output beam.

2. The package as recited in claim 1, wherein said circulator is adapted to separate said first beam has a first polarization state and said second beam has a second polarization state orthogonal to said first polarization state.

3. The package as recited in claim 1, wherein said circulator is adapted to direct said first beam and said second beam to said waveguide.

4. The package as recited in claim 1, wherein said circulator is adapted to change a polarization of said first beam and said second beam so that both said first beam and said second beam have substantially the same polarization state.

5. The package as recited in claim 1, wherein said circulator comprises:
  - (a) a beam splitter adapted to receive said input beam and output said first beam and said second beam; and
  - (b) at least one polarization shifting component adapted to receive said first beam and said second beam and change said first polarization state and said second polarization state to a polarization state common to both said first beam and said second beam.

6. The package as recited in claim 1, wherein said waveguide comprises a first waveguide and a second waveguide, said first waveguide being adapted to receive said first beam and said second waveguide being adapted to receive said second beam.

7. The package as recited in claim 1, wherein said waveguide comprises a reflective coating adapted to reflect said first beam and said second beam.

8. A waveguide optical amplifier package comprising:
  - (a) a planar waveguide adapted to receive a first beam and a second beam through a first end and output an amplified first beam and an amplified second beam, which have greater power levels than said first beam and said second beam, from said first end;
  - (b) a circulator, optically communicating with said waveguide, having an input port and an output port collocated upon a circulator first end, said circulator being adapted to deliver said first beam and said second beam to said waveguide and being adapted to create an output beam from said first amplified beam and said second amplified beam, said output beam being output from said circulator at said output port.
9. The package as recited in claim 8, wherein said circulator is adapted to separate said first beam that has a first polarization state and said second beam that has a second polarization state orthogonal to said first polarization state.
10. The package as recited in claim 8, wherein said circulator is adapted to direct said first beam and said second beam to said waveguide.
11. The package as recited in claim 8, wherein said circulator is adapted to change a polarization of said first beam and said second beam so that both said first beam and said second beam have substantially the same polarization state.

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12. The package as recited in claim 8, wherein said input port is disposed from said output port on said circulator first end.

13. The package as recited in claim 8, wherein said circulator comprises:

(a) a beam splitter adapted to receive said input beam and output said first beam and said second beam; and

(b) at least one polarization shifting component adapted to receive said first beam and said second beam and change said first polarization state and said second polarization state to a polarization state common to both said first beam and said second beam.

14. The package as recited in claim 13, wherein said at least one polarization shifting component comprises:

a first pair of optical components optically communicating with said beam splitter, said first pair of optical components comprising at least one first waveplate and at least one first Faraday rotator;

a plurality of crystal wedges optically communicating with said first pair of optical components; and

a second pair of optical components optically communicating with said plurality of wedges and said waveguide, said second pair of optical components comprising at least one second waveplate and at least one second Faraday rotator.

15. The package as recited in claim 13, wherein said at least one polarization shifting component comprises:

a first pair of optical components optically communicating with said beam splitter, said first pair of optical components comprising at least one first waveplate and at least one first Faraday rotator;

a beam shifting assembly optically communicating with said first pair of optical components, said beam shifting assembly comprising a pair of crystal wedges and a beam displacer; and

a second pair of optical components optically communicating with said beam shifting assembly and said waveguide, said second pair of optical components comprising at least one second waveplate and at least one second Faraday rotator.

16. The package as recited in claim 13, wherein said at least one polarization component comprises at least one of a waveplate, a Faraday rotator, and a wedge.

17. The package as recited in claim 8, wherein said waveguide comprises a first waveguide and a second waveguide, said first waveguide being adapted to receive said first beam and said second waveguide being adapted to receive said second beam.

18. The package as recited in claim 17, wherein said waveguide comprises a reflective coating adapted to reflect said first beam and said second beam.

19. The package as recited in claim 8, wherein said waveguide comprises a U-shaped waveguide.

20. The package as recited in claim 19, wherein said U-shaped waveguide is angularly orientate relative to a normal of said first end of said waveguide.

21. The package as recited in claim 8, wherein said waveguide comprises at least one amplifier waveguide.

22. The package as recited in claim 8, wherein said waveguide comprises at least one tunable filter waveguide.

23. The package as recited in claim 8, further comprising a TO package cooperating with said waveguide and said circulator.

24. The package as recited in claim 23, wherein said waveguide is incorporated within said TO package.

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25. A waveguide optical amplifier package that receives an input beam from an input optical fiber and delivers an output beam to an output fiber, said package comprising:

- (a) a circulator adapted to receive the input beam from the input optical fiber and deliver the output beam to the output optical fiber, said circulator comprising:
  - (i) an input port adapted to receive said input beam;
  - (ii) an output port adapted to output said output port, said input port and said output port being collocated upon a first circulator end of said circulator; and
  - (iii) a core adapted to receive said input beam, separate said input beam into a first beam and a second beam, and change a polarization state of at least one of said first beam and said second beam so that both said first beam and said second beam have a common polarization state; and
- (b) a planar waveguide comprising:
  - (i) a first end adapted to receive said first beam and said second beam; and
  - (ii) a second end adapted to reflect said first beam and said second beam so that said first beam and said second beam are output at said first end, wherein a power level of each of said first beam and second beam is increased as said first beam and said second beam traverse said waveguide.

26. The package as recited in claim 25, wherein said core comprises:

- (a) a beam splitter adapted to receive said input beam and output said first beam and said second beam; and
- (b) at least one polarization shifting component adapted to receive said first beam and said second beam and change said first polarization state and said second polarization state to a polarization state common to both said first beam and said second beam.

27. The package as recited in claim 26, wherein said at least one polarization shifting component comprises:

- a first pair of optical components optically communicating with said beam splitter, said first pair of optical components comprising at least one first waveplate and at least one first Faraday rotator;
- a plurality of crystal wedges optically communicating with said first pair of optical components; and
- a second pair of optical components optically communicating with said plurality of wedges and said waveguide, said second pair of optical components comprising at least one second waveplate and at least one second Faraday rotator.

28. The package as recited in claim 26, wherein said at least one polarization shifting component comprises:

a first pair of optical components optically communicating with said beam splitter, said first pair of optical components comprising at least one first waveplate and at least one first Faraday rotator;

a beam position shifting assembly optically communicating with said first pair of optical components, said beam position shifting assembly comprising a pair of crystal wedges and a beam displacer; and

a second pair of optical components optically communicating with said beam position shifting assembly and said waveguide, said second pair of optical components comprising at least one second waveplate and at least one second Faraday rotator.

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